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THE STATISTICAL REGULATION OF THE TURNING PROCESS

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Abstract

This article has been handled of statistics pursing of capability process of turning by screws production in RIBE Slovakia, k.s. Objective of the statistical assessment process is to determine whether all major manageable causes of instability of the process have been removed. The basis for statistical regulation is management of production processes. If a process operates with large number of random effects, the resulting distribution has the character of a normal distribution. As the result showed on based of quality control charts for average and standard deviation (X, R) we are able to say that the turning process is under the statistics control.

Key words

process, stability, regulation, capability, specification limit

Introduction

In technical practice, an important group of statistic methods are formed by analyze of qualification of measures, production equipment and qualification of process. From statistic methods mentioned above the most used one is examination of process qualification. By the term „process qualification“ we mean ability of the process to observe technical parameters required by value and tolerance limits.

Objective of the statistical assessment process is to determine whether all major manageable causes of instability of the process have been removed. It is necessary, that average value of observed reference of quality and its variability have been constant over time. It can be managed through control charts and forms the preparatory stage of statistical control.

The basis for statistical regulation is management of production processes. Production process is consider to be managed when there are active only accidental impacts. If a process operates with large number of random effects, the resulting distribution has the character of a normal distribution (3).

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Currently, the process capability assessed by indicators process capability Cp (characterizes the scattering process) and Cpk (characterizing the position of the tolerance field process). Processes are considered as eligible if the index Cp and Cpk greater than 1.33.

Input data which is necessary to know prior to the survey process capability are:

- manufacturing conditions of mass production,
- capable measuring equipment,
- capable manufacturing facility
- statistically manageed process,
- assess normality,
- technical and other specifications accurately reflecting the requirements of the customer,
- nominal value of the proposal is in the middle of the tolerance field.

By using this method is necessary that information and knowledge from previous observations of the process are considered and applied.

Materials and methods

Description of the turning process

Operating step: turning by production order WZ 12 860 B RIBE ISR – axial screw
Mark*:* slot width
Rating value: $1{,}62^{+0{,}08}$ mm
Lower Specification limit (LSL): *1,62 mm*
Upper Specification limit (USL): *1,70 mm*
Check centre: *profiloprojector Mitutoyo with precision 0,001 mm*
Production device: *turning machine TRAUB TB 30*
Volume of subgroup: *N = 250 screws*
Measure of subgroup: *n = 5 screws*
Interval of taking: *every 30 minutes*
Number of subgroups: *k = 50*

Calculation of specification limits

Regulation charts are working with data from the manufacturing processes at approximately regular intervals (in hours or quantities). Each subgroup consists of the same product or service. Each subgroup to obtains one or more characteristics of the subgroup. The Shewhart control chart is a graph of values of the characteristics of the subgroups compared to subgroup number. It consists of a central line (CL) located in the reference value of visualization features. In evaluating whether the manufacturing processes are or are not in statistically managed state, the reference value is usually considered the average value of data is usually considered the average value of data. Control chart has two statistically established regulation limits, one on each side of the central line, called the upper regulation limit (UCL) and lower regulation limit (LCL). They are at a distance of 3σ on each side of the central line, where σ is standard deviation of the monitored statistics for the file [1].

Average range in subgroups

$$\overline{X_i} = \frac{1}{n}\sum_{j=1}^{n} X_{ij} \qquad [1]$$

i = 1, 2 ....k and j = 1, 2 ...n,

X_{ij} *– measured value in i- subgroups*
J – serial number of measured value in i- subgroups
K – number of subgroups
N – file size

Span in subgroups

$$R_i = MAX(X_{ij}) - MIN(X_{ij}) \qquad [2]$$

i = 1, 2 ... k and j = 1, 2 ...n
MAX (X_{ij}) *and MIN*(X_{ij}) *is maximum and minimum value in i-th subgroup.*

Average of process

$$\overline{\overline{X}} = \frac{1}{k}\sum_{i=1}^{k} \overline{X_i} \qquad [3]$$

$\overline{X_i}$ *- average of j – th subgroup*

Average of span

$$\overline{R} = \frac{1}{k}\sum_{i=1}^{k} R_i \qquad [4]$$

R_iX_i are spans and averages in *i*-th subgroups (*i*=1, 2, ...*k*). $\overline{R}$ and $\overline{\overline{X}}$ in quality control charts are central lines (*CL*).

Calculation of specification limits

$$UCL_R = D_4 \,.\, \overline{R} \qquad [5]$$
$$LCL_R = D_3 \,.\, \overline{R} \qquad [6]$$
$$UCL_{\overline{X}} = \overline{\overline{X}} + A_2 .\, \overline{R} \qquad [7]$$
$$LCL_{\overline{X}} = \overline{\overline{X}} - A_2 .\, \overline{R} \qquad [8]$$

where D_4 ,D_3 and A_2 are constants moving in dependence on volume of subgroups *n,* in our case n = 5: D_3 = 0,000, D_4 = 2,114, A_2 = 0,577.

Results

In turning process we obtained values for 50 subgroups. Characteristics $\overline{X}$ and R are applied in quality control charts. For quality control charts $(\overline{X}, R)$ (Fig. 1) are valid these regulation limits:

UCL_X = 1,6758 mm UCL_R = 0,04525 mm
LCL_X = 1,6448 mm

General average $\overline{\overline{X}}$ = 1,66016 mm, average span $\overline{R}$ = 0,054 mm. The process is considered as eligible, all measured values are inside the regulation zone.

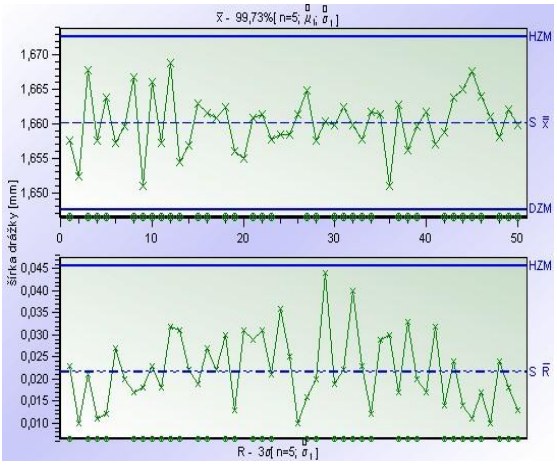

Fig. 1 *Quality control chart (X, R)*

We can see the process variance in histogram (Fig. 2), where the position of the process was appreciated, variability and figure compared to tolerance zone. Based on the bell-shaped histogram, we note the confirmation of normality; the process runs at constant conditions. All measured values are inside the tolerance zone.

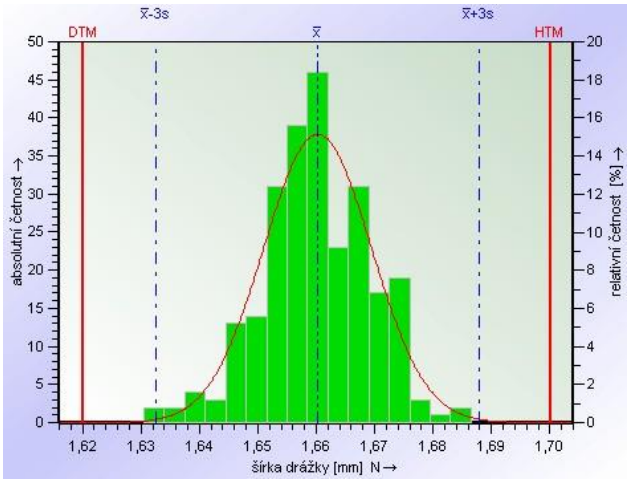

Fig. 2 *Histogram*

Summary

The capability of turning process in RIBE Slovakia, k.s. showed that the process provides the products that meet the claimed quality criteria. The process is considered as eligible, all measured values are inside the regulation zone. The process is able to provide the products in compliance with the tolerance zones.

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